



The Hong Kong University of Science and Technology

Department of Mathematics

PhD THESIS EXAMINATION

Statistical Analysis of Mixtures of Matrix Valued Data

By

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ABSTRACT

In the past decade, there has been a surge of interest in processing and analyzing mixture matrix-valued models arising in many scientific fields such as genomics, neuroimaging, and social network analysis. Owing to the ultra-large dimensions of the observed matrices, recent works have assumed certain types of low-rankness for the underlying parameters of interest. Such low-rankness assumption is also well-motivated in practice, as many datasets exhibit low-rank structure due to shared latent factors or sparse interactions among variables. Unlike the promising empirical performance of various mixture matrix-valued models, their theoretical properties were less justified. This motivates our first part of the thesis, focusing on fundamental limits of estimation in low-rank Gaussian mixture model (LrMM) and revealing a statistical-to-computational gap. Another related yet more practical task in LrMM is clustering. In the second part of the thesis, we develop an modified Lloyd's algorithm that utilizes the planted low-rankness with optimal error rate. The algorithm has been extensively evaluated on both synthetic and real-world datasets with appealing performance. The third part of the thesis shifts focus to network data. We propose a flexible mixture model concerning multi-layer networks, together with a tensor-based algorithm to consistently recovering local/global communities of nodes as well as labels of networks, and its application on real datasets yields new and interesting findings.

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Time : 3:00 pm

Venue : Room 1409 (Lifts 25/26)

Thesis Examination Committee:

- Chairman** : Prof. Toyotaka ISHIBASHI, LIFS/HKUST
- Thesis Supervisor** : Prof. Dong XIA, MATH/HKUST
- Thesis Supervisor** : Prof. Xinzhou GUO, MATH/HKUST
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- External Examiner** : Prof. Junhui WANG, Department of Statistics/
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(Open to all faculty and students)

The student's thesis is now being displayed on the reception counter in the General Administration Office (Room 3461).